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Abstract

Over the past 10 years, financial firms have increased the size of their positions in the oil futures market. At the same time, oil prices have increased dramatically. The conjunction of these developments has led some observers to argue that financial speculation caused the run-up in oil prices. Yet several arguments cast doubt on the validity of this claim. First, although the stock of open futures contracts is many times larger than the flow of oil consumption in the United States, comparing these two statistics is misleading. Stocks are not measured with respect to a specific unit of time but flows are, so the two are not directly comparable. Second, empirical analysis shows that changes in financial firms' positions do not predict oil-price changes, but that oil-price changes predict changes in positions. Third, the evidence indicates that financial firms' positions did not cause the market to expect persistent price increases during 2007/08. Other explanations for the increase in oil prices include macroeconomic fundamentals, such as interest rates and increased demand from emerging Asia. Of these two explanations, the one that seems most consistent with the facts explains oil-price fluctuations in terms of large and persistent demand shocks related to growth in global real activity in the presence of supply constraints.

JEL classification: Q41, G12
Bank classification: International topics

Résumé

Au cours des dix dernières années, les sociétés financières ont accru la taille de leurs positions sur le marché à terme du pétrole. Parallèlement, les prix du pétrole ont connu une augmentation spectaculaire. Cette double évolution a amené certains observateurs à postuler que la spéculation financière était à l'origine de l'envolée des prix du produit, mais plusieurs arguments jettent le doute sur la validité d'une telle hypothèse. Premièrement, bien que le stock de positions ouvertes sur le marché à terme soit largement supérieur au flux de consommation de pétrole aux États-Unis, la comparaison de ces deux statistiques est trompeuse. Contrairement aux flux, les stocks ne sont pas mesurés sur une unité de temps précise, de sorte que les deux ne sont pas directement comparables. Deuxièmement, l'analyse empirique montre que les variations des positions des sociétés financières ne permettent pas de prévoir celles des prix du pétrole, mais que la réciproque est vraie. Troisièmement, les observations indiquent que les positions des sociétés financières n'ont pas amené le marché à anticiper des hausses de prix persistantes en 2007-2008. Parmi les autres causes possibles de la montée des prix du pétrole, on avance les variables macroéconomiques fondamentales, telles que les taux

d'intérêt et la demande accrue des pays émergents d'Asie. Des deux explications, celle qui semble cadrer le mieux avec les faits associe les fluctuations des prix du pétrole aux chocs de demande importants et persistants liés à l'expansion de l'activité réelle mondiale en présence de contraintes de l'offre.

Classification JEL : Q41, G12
Classification de la Banque : Questions internationales

1 Introduction

The increase in the price of crude oil since 2003, its sharp spike at $142 per barrel in July 2008 and its subsequent collapse in the autumn of 2008 have raised questions about the role of financial speculation in determining the price of oil. Attributing these wide fluctuations to financial factors is plausible because investors have come to view commodities as a distinct asset class. This portfolio shift has led to large financial flows into the oil futures market, as well as other commodity futures markets (Bank for International Settlements 2008). Estimates indicate that, by June 2008, the total value of commodity index-related trading funds held by institutional investors was worth approximately $200 billion, up from about $13 billion at the end of 2003 (Commodity Futures Trading Commission 2008; Masters 2008). Also by June 2008, investment in NYMEX crude oil ($51 billion) made up about one-third of the total value of commodity index investment in U.S. markets (Commodity Futures Trading Commission 2008). At the same time, the price of oil reached unprecedented heights, increasing from $32 per barrel at the end of 2003 to $142 in July 2008 (Figure 1). To many observers, the conjunction of these two trends suggests a causal connection between financial speculation and the increase in the price of oil. In this paper, we examine the evidence for this claim.

Figure 1. Spot Price of Oil

Source: NYMEX

Understanding the relationship between financial speculation and oil prices is an important issue confronting Canadian policy-makers. Since oil makes up about 35 per cent of Canadian commodity production, understanding the effect of speculative financial flows on oil prices has

immediate implications for the Canadian economy.[1] Furthermore, the fairly tight and long-standing relationship between energy prices and the Canadian dollar implies that fluctuations in oil prices affect the overall competitiveness of Canadian exports in the rest of the world. Changes in the value of the Canadian dollar related to financial speculation in the oil futures market could have important effects on the allocation of resources among different sectors of the Canadian economy. A sectoral reallocation of capital and labour unrelated to fundamental macroeconomic conditions would be inefficient and may call for offsetting macroeconomic policy actions.

We begin by defining the term "financial speculation" in a commodity market and discuss some of the issues surrounding how it is used. We then examine the arguments about how the increase in the number of financial investors could have led to increases in the price of oil from 2003–08, and present evidence on whether changes in financial investors' positions affected spot prices. Three important arguments are that: (i) the growth in the number of open futures positions increased oil prices; (ii) the open positions of financial firms caused the increase; and (iii) financial firms' open positions affected market expectations of future spot price increases and, hence, distorted the incentive to store oil. Finally, we assess the extent to which macroeconomic fundamentals explain the recent run-up in oil prices by considering two prominent explanations: (i) persistently low real interest rates, and (ii) rapid increases in the demand for oil driven by unexpectedly strong growth in the global economy. Overall, we find that financial speculation does not seem to have played an important role in the price run-up. Currently, the available evidence supports the view that macroeconomic fundamentals explain the increases in the price of oil witnessed during 2007/08.

2 What Is Financial Speculation in Commodity Markets?

We define "speculation" as a firm holding a net position, either long or short, in the expectation of earning a positive return, and not because it is a commercial user of oil (see Working 1960). By contrast, we define "hedging" as transacting in a commodity futures market because such transactions are tied to a firm's operations, including processing, merchandising or marketing the commodity (see Peck 1985).

These definitions are standard and consistent with those used by regulatory agencies. For example, the Commodity Futures Trading Commission (CFTC) makes a distinction between "commercial" and "non-commercial" firms, with commercials being considered "hedgers" and non-commercials "speculators." But classifying firms in this way is not completely clear cut, because commercials can take speculative positions and non-commercials can hedge exposure to

[1] The ratios are based on nominal values for the year 2007.

price risk. It is more realistic to think of the behaviour of hedgers and speculators as arrayed along a continuum, with some speculating, some hedging and some doing both.

Recognizing the inherent imprecision of these categories, we nevertheless adopt them, for a pragmatic reason. The entire debate among policy-makers and academics about speculation in the oil futures market has been guided by the proposition that financial firms (i.e., non-commercials) may have driven oil prices away from the value consistent with economic fundamentals (Bank for International Settlements 2008; International Monetary Fund 2006, 2008; Masters 2008; Hamilton 2009). It is thus natural to examine this specific proposition, subject to the caveat that firms' motives are unobservable.

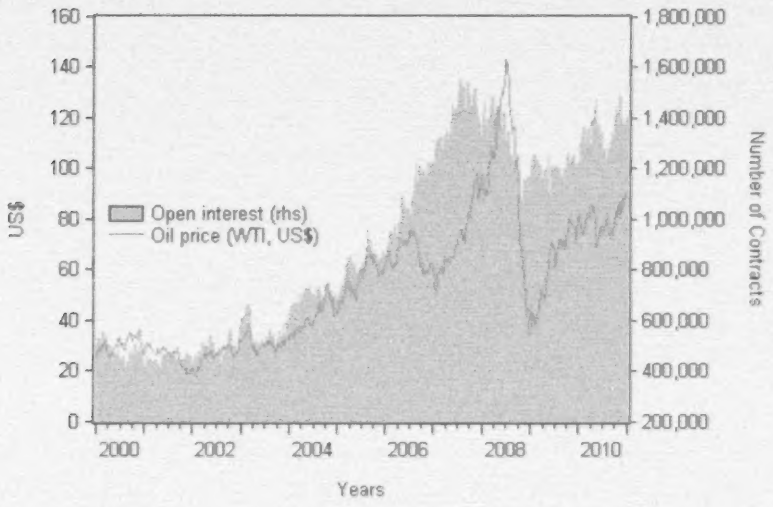
3 Financial Speculation in the Oil Futures Market

In this section, we examine three of the main arguments in favour of financial speculation: (i) the overall increase in activity in the oil futures market; (ii) the effect of non-commercial firms' positions; and (iii) the effect of non-commercial firms on market expectations.

3.1 Open interest and volume in the oil futures market

Since the early 2000s, the diffusion of financial instruments based on commodity indexes including oil has permitted investors to assume greater exposure to commodity-price risk. The promotion of these instruments was motivated by the finding that the returns of commodity indexes provided an opportunity for diversification, thereby improving the risk-return trade-off (Gorton and Rouwenhorst 2006). As a result, open interest and the volume of oil futures contracts have increased over the past 10 years. "Open interest" measures the total number of futures contracts, either long or short, that have been entered into and that have not yet been liquidated by an offsetting transaction or fulfilled by delivery. The volume of futures contracts traded is the quantity of contracts that changes hands and measures the level of trading activity. Figure 2 shows that the total amount of open interest increased in the first half of 2008, when the price of oil reached unprecedented levels. Between January 2003 and June 2008, open interest in West Texas Intermediate (WTI) futures contracts more than doubled, from about 600,000 contracts to about 1.3 million, and as the price collapsed in the wake of the financial crisis, open interest fell as well. In the last few months of 2010, open interest in oil futures contracts increased again.

Figure 2. Open Interest and the Spot Price of Oil



Sources: Commodity Futures Trading Commission and NYMEX

These developments have been interpreted by some observers as prima facie evidence for the importance of financial speculation in the oil futures market. In particular, it is common to compare the amount of open interest in the futures market to U.S. daily consumption and use the fact that open interest is many times larger than U.S. daily consumption to infer the presence of speculative pressures (Cho 2008; Masters 2008). In addition, Khan (2009) points out that the ratio of average daily trading volume to global oil production has grown steadily and that, by late 2009, this ratio exceeded 15.

Yet these interpretations are misconceived. First, open interest is a stock variable, which is measured at a point in time, whereas U.S. daily consumption is a flow variable, measured per unit of time, so the two series are not directly comparable.[2] Second, the fact that the volume of transactions in the oil futures market is larger than physical production does not take into account that contracts in a single position are often deliverable over many months.[3]

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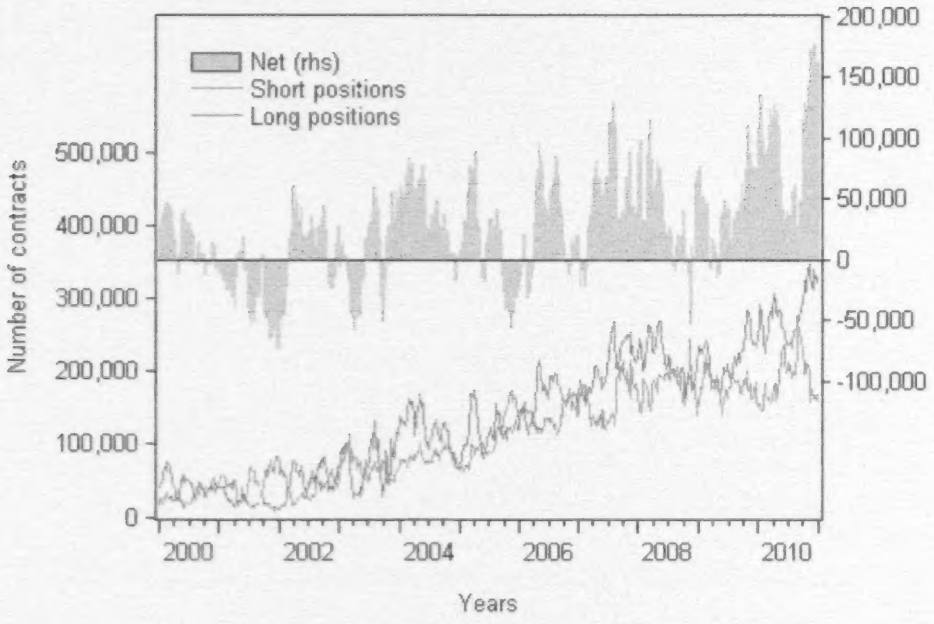
[2] Since a stock is not associated with any specific interval of time and a flow variable is, one can choose an arbitrary unit of time over which to measure a flow variable and scale the ratio of open interest to U.S. consumption to be as large or small as one likes. For instance, a widely cited *Washington Post* article (Cho 2008) pointed out that a single energy firm took a long futures position in the NYMEX oil futures contract equivalent to about three times U.S. daily consumption. This seems large, but it is smaller if we compare the number of notional barrels of oil implied by the position to annual U.S. consumption.

[3] Once the maturities of different contracts are reconciled, the volume of futures contracts for delivery in a given month was a fraction, rather than a multiple, of global physical production during 2007/08, the period when futures contracts were the most heavily traded (Ripple 2008, Table 2).

3.2 Non-commercial firms and the price of oil

The share of non-commercial firms in total open interest on the NYMEX market grew dramatically from less than 20 per cent in 2000 to more than 40 per cent in 2008 (Büyükşahin et al. 2008). In addition, non-commercial firms as a group have tended to take long positions since 2000 by buying near-term contracts and rolling them over as the maturity of the contract approaches (Figure 3).[4] For these two reasons, some analysts have considered the possibility that the increase in oil prices is attributable to the market impact of non-commercial firms (e.g., Interagency Task Force on Commodity Markets 2008). This hypothesis relies on the premise that if a large number of non-commercial firms (such as hedge funds) use positive feedback trading rules, they can artificially amplify a market move (Fung and Hsieh 2000).

Figure 3. Non-Commercial Firms' Positions



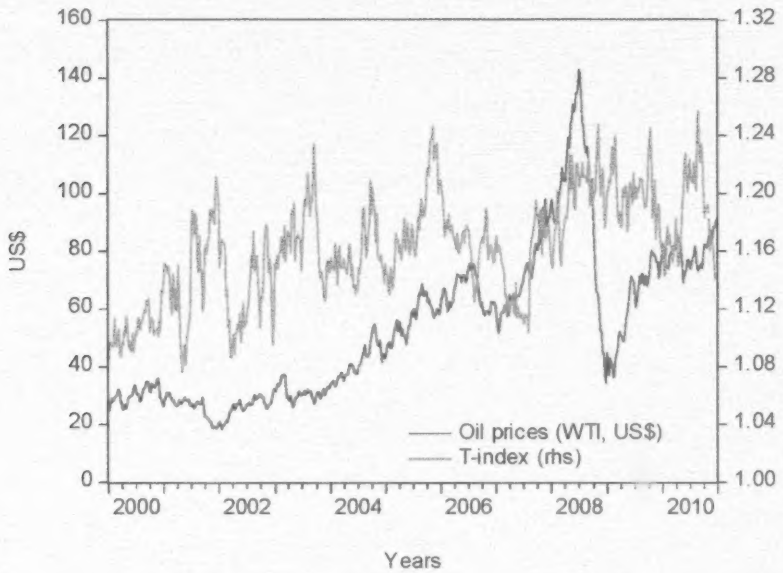
Sources: CFTC and authors' calculations

We use Working's T-index to examine the importance of non-commercial firms (Working 1960; Till 2009; Sanders, Irwin and Merrin 2010).[5] The index is bounded below by unity, and larger values indicate a greater number of open non-commercial positions relative to commercial

[4] These positions are measured by netting out the total amount of non-commercial open interest that is short oil futures contracts from the total amount of non-commercial open interest that is long oil futures contracts.
[5] The details on the construction of this index are described in the appendix.

positions. To the extent that the positions taken by the non-commercial firms do not offset those taken by the commercial firms, the size of this imbalance is indicative of speculative positions in excess of the requirements of hedgers. As Figure 4 shows, the index increased in 2008 at the same time that the price of oil increased so dramatically, but it also reached similar levels in 2003 and 2005 when oil prices were lower. Moreover, despite record net long non-commercial positions at the end of 2010, the T-index suggests that speculative pressures were subdued, given the greater hedging demand by commercial firms.

Figure 4. T-Index and the Spot Price of Oil



Sources: CFTC and authors' calculations

If the broader participation of financial investors caused the increase in the price of oil, a necessary condition is that changes in financial firms' positions temporally precede changes in the price of oil. To examine this question, as well as the related question of whether changes in non-commercial firms' net open positions caused price changes, we conduct bivariate and conditional Granger causality tests (Granger 1969). All of the data come from the CFTC's weekly Commitments of Traders reports that record the positions of commercial and non-commercial firms.[6] We examine the evidence over the full sample (1993M1–2010M12), as well as two subsamples (2003M1–2008M6 and 2003M1–2010M12).[7]

[6] These data are available at <http://www.cftc.gov/marketreports/commitmentsoftraders/index.htm>.

[7] While, because of data constraints, we cannot directly compare the results of similar tests provided by the Interagency Task Force on Commodity Markets (2008) report, we are able to mimic closely the results obtained with public data reported in the International Monetary Fund's "World Economic Outlook" (IMF 2006) and "Global Financial Stability Report" (IMF 2008). Furthermore, the data used to construct the T-index in Till (2009) begin only in 2006, so we construct an alternative index that uses less finely disaggregated data to get a longer sample.

Table 1 reports the correlations of the changes in positions with changes in oil prices. Both the contemporaneous and 1-week-ahead correlations are reported. The table indicates that the net long speculative positions are positively but weakly correlated with contemporaneous changes in oil prices, and that commercial positions are negatively correlated with price changes, consistent with hedging activities of commercial firms in the futures market. These correlations are statistically significantly different from 0 at the 5 per cent level. These correlations exhibit a pattern similar to the contemporaneous correlations and they, too, are statistically significantly different from 0 at conventional levels. In addition, the correlations seem higher, but the lack of cross-sectional variation does not permit us to conduct a formal test of whether these differences are statistically significant. This evidence warrants a more formal examination of the time-series relationship between changes in traders' positions and changes in oil prices.

Table 1. Correlations of Changes in Positions with Changes in Oil Prices

		1993M1–2010M12	2003M1–2008M6	2003M1–2010M12
Changes in non-commercial net positions	t	0.23	0.28	0.21
	$t+1$	0.36	0.38	0.26
Changes in commercial positions	t	-0.23	-0.22	-0.16
	$t+1$	-0.39	-0.41	-0.28

Note: These are the correlation coefficients of the first differences of the log of oil prices with changes in non-commercial net positions and commercial net positions. All the coefficients are statistically significant.

The Granger causality tests reported in Table 2 do not reveal strong evidence in favour of the hypothesis that changes in non-commercial traders' positions affected oil prices for the relevant period. For the full sample, we reject the null hypothesis that the changes in the positions of both non-commercial and commercial firms do not forecast subsequent changes in prices, but we also reject the null hypothesis that changes in prices help to predict the changes in firms' positions. Thus, the test for the full sample is inconclusive – the evidence suggests that the direction of predictability goes both ways. It is important to stress, however, that this rejection of the null hypothesis is highly sensitive to the lag-length specification and sensitive to the start date of the sample. For instance, using the Schwarz criterion and/or starting the sample in 1996 would result in non-rejection of this null hypothesis. By contrast, the finding of predictability from oil-price changes to non-commercial positions is robust across a variety of specifications and does not exhibit the same degree of sensitivity to specific choices of lag lengths.

The most relevant period for this paper is from 2003 onward, when open interest began to increase in conjunction with oil prices, as shown in Figure 2. During this period, we are unable to reject the null hypothesis that changes in positions do not forecast changes in the price of oil. That is, there is no statistical evidence that changes in firms' positions temporally preceded oil-price increases during the period when speculative activity was thought to be an important driver

of these price changes. But we are able to reject the null hypothesis that changes in the price of oil do not predict changes in the net positions of commercial and non-commercial firms. Thus, changes in positions do not predict oil-price changes, but changes in oil prices do predict changes in positions. These results are very similar to those reported by the Interagency Task Force on Commodity Markets (2008) and the IMF (2006, 2008). They are also consistent with the available evidence in agricultural commodity markets (Irwin and Sanders 2010).

Of course, these tests omit many other possible drivers of traders' positions that are observable at weekly frequency. For example, it is plausible that news about global demand for commodities drives both traders' positions and oil prices, so that the correlation between the two variables is due to this unmodelled variable. High-frequency indicators of global demand are not readily available, but there are measures available at weekly frequency, such as the Baltic Dry Index. Similar indicators measured at monthly frequency have been used in the literature as proxies for demand pressures in international commodity markets (e.g., Kilian 2009). Using the Baltic Dry Index to control for demand effects yields qualitatively similar results as the ones reported in Table 2.[8]

Table 2. Granger Causality Tests

	1993M1–2010M12	2003M1–2008M6	2003M1–2010M12
Non-Commercial			
Do changes in net positions predict price changes?	**Yes**	No	No
Do price changes predict changes in net positions?	**Yes**	**Yes**	**Yes**
Commercial			
Do changes in net positions predict price changes?	**Yes**	No	No
Do price changes predict changes in net positions?	**Yes**	**Yes**	**Yes**

Notes: The change in price is the log change in the spot price of oil. The net positions of the commercial and non-commercial firms are defined as the net (long – short) open position. The null hypothesis is no Granger causality between the two variables. An entry of "Yes" indicates that we reject the null hypothesis of no Granger causality at the 5 per cent significance level; an entry of "No" indicates that we fail to reject the null hypothesis of no Granger causality at the 5 per cent significance level. The number of lags in the Granger causality tests was chosen based on the Akaike Information Criterion (AIC).

3.3 Non-commercial firms and market expectations

The ability to hold oil inventories links the spot and futures markets, and this link implies that the effect of financial speculation, if any, should be reflected in the physical market for oil. The entry of non-commercial firms could have affected market expectations of future price increases, the incentive to store oil, and thus reduced the current quantity of oil available on the physical

[8] The results of these regressions are available upon request.

market. If the net long positions of the non-commercial firms had affected market expectations of the future spot price, proxied by the current futures price, financial speculation by non-commercial firms would have created an incentive to accumulate oil inventories not justified by economic fundamentals. As Table 3 shows, however, non-commercial net open interest does not lead the futures-spot spread in either the full sample or the two subsamples.

Table 3. Granger Causality Tests for the Futures-Spot Spread

	1993M1–2010M12	2003M1–2008M6	2003M1–2009M12
Non-Commercial			
Do changes in net positions predict spreads?	No	No	No
Do spreads predict changes in net positions?	**Yes**	**Yes**	**Yes**
Commercial			
Do changes in net positions predict spreads?	No	No	No
Do spreads predict changes in net positions?	**Yes**	**Yes**	**Yes**

Notes: See Table 1. "Spread" is the futures-spot spread and is defined as $f_t^{(12)} - s_t - i_t$, where $f_t^{(12)}$ is the log futures price for delivery of oil in 12 months; s_t is the log spot price of oil; and i_t is the yield of the 12-month U.S. Treasury bill.

The available evidence on commercial stocks of oil also casts doubt on the proposition that non-commercial firms distorted the incentive to store oil. In any commodity market, the ability to store the commodity ties together the spot and futures markets. Adjusted for storage and interest rate costs, persistently high futures prices relative to the current spot price give firms an incentive to accumulate inventories. Figure 5 shows that the global stock-to-production ratio declined during 2007/08. At the same time, the futures curve was downward-sloping, so that the futures-spot spread was negative. If non-commercial firms had created expectations of persistently high prices, it would have been more natural to observe the accumulation of stocks and an upward-sloping futures curve. Furthermore, in the United States, where the data on privately held stocks of oil are the most reliable, inventories of oil during the first half of 2008 were below those prevailing in 2005/07 (U.S. Energy Information Administration 2008; Smith 2009). To the extent that there are questions about the methods used to measure oil inventories in different OECD countries and the reliability of the aggregate series, the fact that we observed similar inventory behaviour in both the United States and the rest of the OECD lends credibility to this argument.

Another way to store oil is by not extracting it, so it is also important to consider the possibility that financial speculation altered the incentive to supply oil. But the physical supply of oil does not exhibit any substantial decrease during the relevant period. Figure 6 shows that global oil production also remained stable between 2004 and 2008.

Figure 5. OECD Stock-Production Ratio and Spot Price of Oil

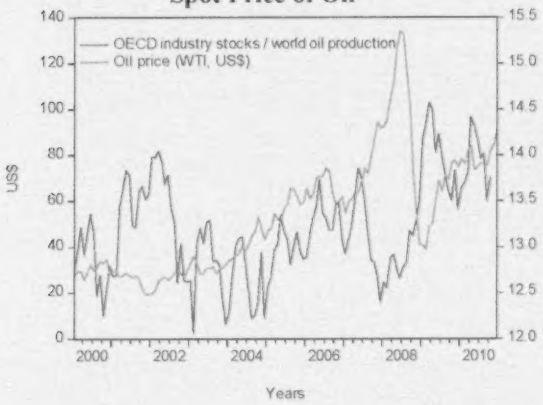
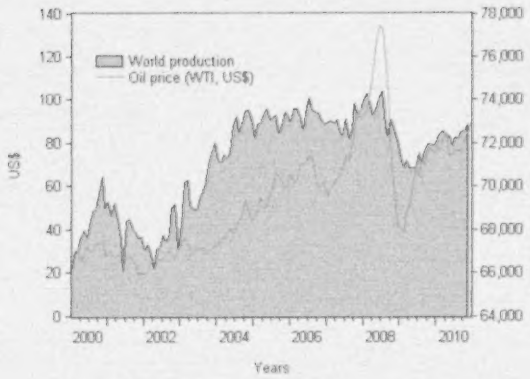


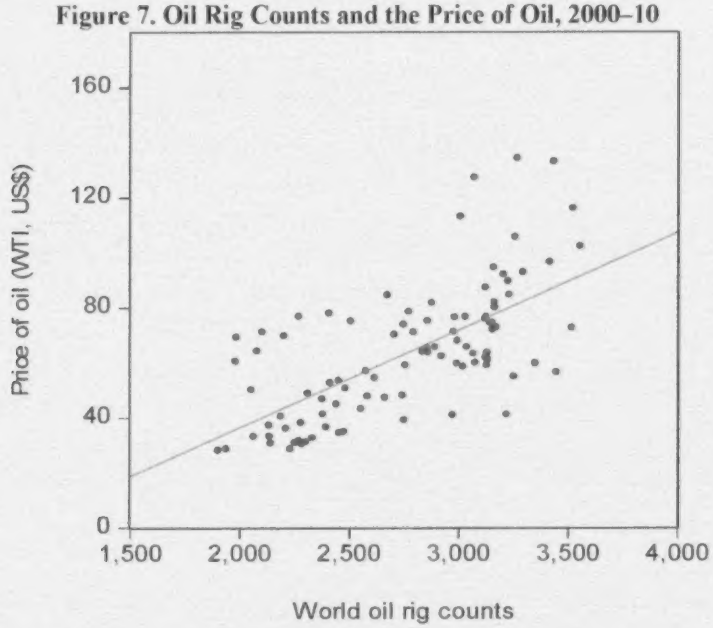
Figure 6. Global Oil Production and the Spot Price of Oil



Sources: International Energy Agency and authors' calculations

Indeed, the high price of oil stimulated efforts to bring new oil wells on line (Figure 7). The pace of drilling for new oil wells accelerated in response to the increase in the price of oil in 2007/08, and did not abate until after the price reached its peak in July 2008 (Smith 2009). Taken together, this evidence suggests that the behaviour of non-commercial firms did not exert an effect on the incentive to accumulate oil stocks and thereby reduce the current supply of oil.

Figure 7. Oil Rig Counts and the Price of Oil, 2000–10



Sources: Baker Hughes and authors' calculations

4 Fundamental Macroeconomic Conditions Driving the Price of Crude Oil

We next examine two explanations for the increase in the price of oil based on macroeconomic fundamentals. The first one attributes the surge in prices to the effect of historically low real interest rates on the demand for, and supply of, oil. The second explanation attributes the price increase to increases in demand related to the global business cycle.

4.1 Real interest rates and the price of oil

The first explanation attributes the increase in oil prices to the effect of historically low real interest rates on demand and supply conditions in the global oil market (Frankel and Rose 2009). Low real interest rates simultaneously increase the demand for storable commodities and decrease the supply through three main channels. First, low real interest rates increase the refiners' incentive to carry inventories by reducing the opportunity cost of doing so. Second, they decrease the oil producers' incentive to extract oil today by increasing the future value of oil deposits. Third, they encourage investors to shift investments out of the risk-free asset and to the spot market for commodities, increasing current demand for commodities.[9]

Despite the compelling economic logic of this reasoning, however, there is little evidence in favour of it. Frankel and Rose's evidence indicates that both macroeconomic variables (e.g., global real activity) and microeconomic variables (e.g., inventories) play a role in determining commodity prices, but they do not find any evidence that the real interest rate accounts for the run-up in the price of oil, conditional on the other covariates.[10] This conclusion is independently corroborated by Anzuini, Lombardi and Pagano (2010), who use a different empirical specification to identify the effect of monetary policy shocks (that is, changes in the nominal interest rate rather than the real interest rate) on oil prices. This specification also admits the possibility that monetary policy shocks can affect commodity prices through indirect channels by stimulating aggregate demand (and, thus, the demand for commodities), as well as influencing the expected path of output growth and inflation. Their results indicate that negative interest rate

[9] Another channel through which low real interest rates may affect oil prices is by increasing investment in oil production. This channel is suggested by the economics of oil production and structural models that include an oil-producing sector (e.g., Lalonde and Muir 2007). For example, non-conventional production such as oil sands and deep-sea drilling, which have become increasingly important over the past decade, require considerable investment, so interest rates can be an important determinant of marginal cost. Although plausible, long lead times in expanding the existing supply of oil ensured that conditions remained tight during the 2003–08 period even when real interest rates were at low levels. On the tight supply conditions in the crude oil market during this period, see International Monetary Fund (2011).

[10] Summarizing their results, Frankel and Rose (2009, 24) state that "there was little support in these new annual results for the hypothesis that easy monetary policy and low real interest rates are an important source of upward pressure on real commodity prices, beyond any effect they might have via real economic activity and inflation."

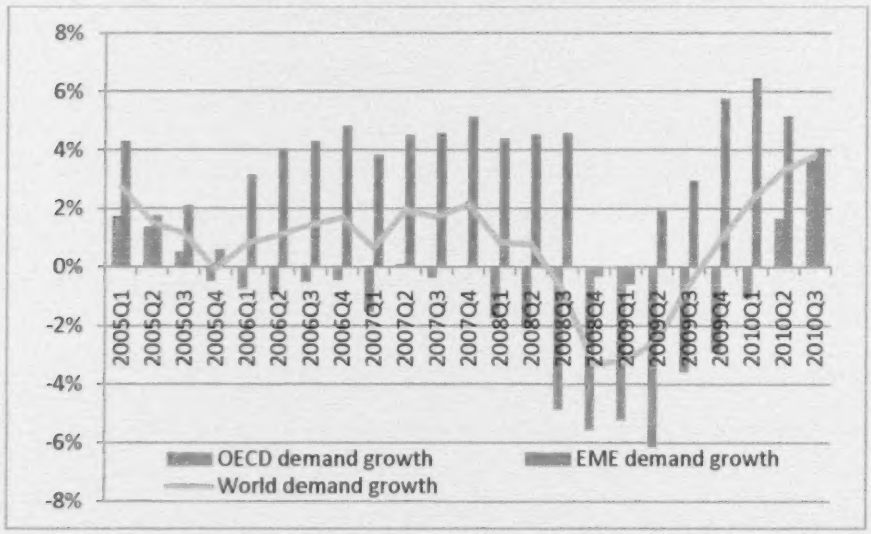
shocks account for only about 5 per cent of the variability in oil prices (Anzuini, Lombardi and Pagano 2010, Figure 3).

4.2 Global demand and supply conditions

The second explanation based on macroeconomic fundamentals attributes the increase in the price of oil to global stagnant supply conditions and large increases in demand from emerging-market economies, which tend to have more energy-intensive production methods than OECD countries. On the demand side, the strong correlation between GDP growth in emerging-market economies and the recent oil-price spike has been widely documented. Kilian and Hicks (2009) document that news about global growth prospects, driven primarily by revisions to GDP growth in emerging Asia, accounts for much of the surge in the price of oil since 2003. In addition, Gervais, Kolet and Lalonde (2010) find that incorporating the share of emerging Asia in world GDP can account for movements in the price of energy commodities. Figure 8 shows that most of the increase in demand since 2006 has come from the emerging-market economies.

On the supply side, conditions in the oil market during this period remained tight despite large investments in increasing capacity (Gervais and Kolet 2009). Figure 8 shows that global demand exceeded global supply in 2007 and the first half of 2008. This evidence lends credence to the argument that rapid increases in demand, in conjunction with a sluggish supply response, contributed to the run-up in the price of crude oil.

Figure 8. Growth in Global Oil Demand (y/y)



Source: International Energy Agency

To assess the plausibility of this explanation, Hamilton (2009) calculates whether the observed change in the price of oil is consistent with estimates of the short-run elasticity of the demand for oil. Such estimates indicate that the price elasticity of the demand for oil is small – around 0.05 to 0.07 (Dahl 1993; Cooper 2003). That is, a 1 per cent increase in the price of crude oil results in a 0.05–0.07 per cent decrease in the quantity demanded. Hamilton uses an estimated elasticity of 0.06 to compute the price increase required to reconcile the increase in the demand for oil with the stagnant supply between 2005 and mid-2008, and finds that $142 per dollar is consistent with such an estimate.[11] But Hamilton's case against financial speculation based on the elasticity of the demand for oil is highly sensitive to the precise value of the elasticity, which is difficult to identify and may vary over time (Baumeister and Peersman 2009). Conducting the same exercise, but assuming an elasticity of demand of 0.10, implies a price change from $55 per barrel to $100 per barrel – much lower than the price that we actually observed.

Kilian and Murphy (2010) address some of the underlying econometric issues by explicitly incorporating oil inventories into a structural model of the global oil market. Their estimate of the short-run elasticity of the demand for oil is larger than that found in other studies: 0.44 rather than 0.06. On the other hand, they also find that the increase in the real price of oil between 2003 and 2008 was driven by fluctuations in global demand conditions. Their analysis using this model suggests that, from 2003, the primary source of oil-price changes was the large and persistent demand shocks associated with positive shocks to global real activity.

5 Conclusion

The weight of the evidence indicates that macroeconomic fundamentals can explain the 2003–08 increase in the price of oil. Financial speculation seems to have played a modest role. Our own analysis suggests that there is no empirical evidence to suggest a strong relationship between the positions of speculators and price changes. Although there is debate about the appropriate way to estimate demand and supply elasticities in the global crude oil market, this technical discussion should not distract us from the fact that global macroeconomic conditions are capable of accounting for the persistent increase in oil prices. Overall, the available evidence points to global demand and supply conditions rather than financial speculation as an explanation for the surge in the price of oil between 2003 and 2008.

[11] The assumption behind the calculation is that, between 2005 and 2008H1, global demand for oil would have grown at the same rate as it did between 2003 and 2005 if the price of oil had remained at $55 per barrel. Using data on the global consumption of crude oil from the U.S. Energy Information Administration, Hamilton estimates that demand in 2008H1 would have been 90.5 million barrels per day under that assumption, whereas the actual consumption was 85.5 million barrels per day. If the price elasticity of the demand for crude oil is 0.06, then the price of oil would have had to increase to $142 per barrel to clear the market. That is,
$\varepsilon = |\ln \Delta Q| / \ln \Delta P = (\ln 90.5 - \ln 85.5)/(\ln 142 - \ln 55) = 0.06.$

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Appendix. Working's (1960) T-Index

Working's T-index is an indicator intended to capture speculative pressure coming from non-commercial firms. It is defined as

$$T = 1 + \frac{SS}{HL + HS} \quad if\ HS \geq HL$$

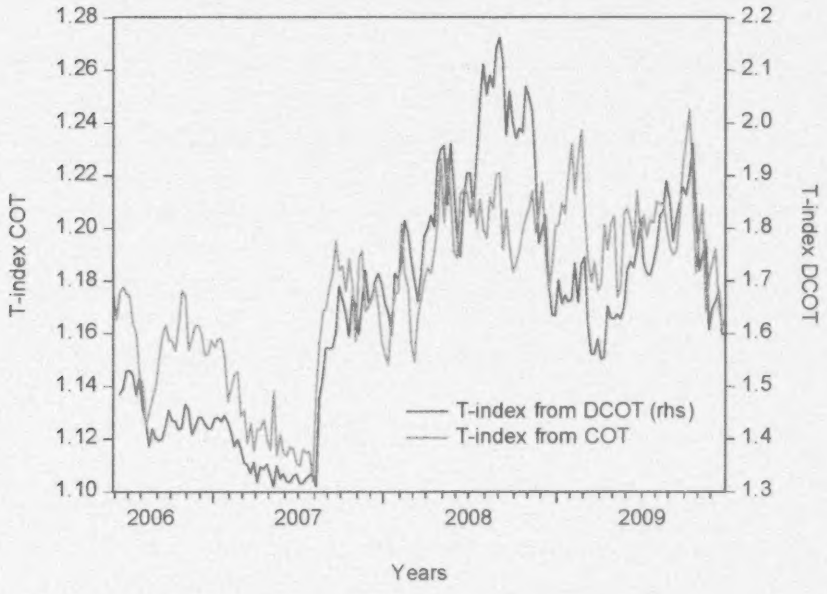
$$T = 1 + \frac{SL}{HL + HS} \quad if\ HS < HL$$

where SS is the open interest of speculators (non-commercial firms) who hold a net short position; SL is the open interest of speculators who hold a net long position; HS is the open interest of hedgers (commercial firms) who hold a net short position; and HL is the open interest of hedgers who hold a net long position.

The rationale underlying Working's index of financial speculation is that speculators are necessary only insofar as they balance the market for hedgers. For example, if there are more short hedgers than long hedgers ($HS \geq HL$), long speculators are required to make up the shortfall in long positions, meet the needs of hedgers and balance the market. The more short speculators present in the market, relative to the total number of hedgers, the more unbalanced the market and, hence, the more speculative pressure.

To construct as long a time series as possible, we use the CFTC's Commitment of Traders (COT) data, which are available from 1993 onwards. By contrast, Till (2009) uses the Disaggregated Commitment of Traders (DCOT) data that are available only through end-2006. The principal difference between our index and Till's index is that Till defines hedgers as "Producers," using the DCOT, whereas we use the broader "Commercial Traders" definition from the COT. The COT data also include positions for non-reportable traders, which we categorize as non-commercial traders in the calculation of the T-index. Despite these differences, the broad movements of the indexes are similar (Figure 9).

Figure 9. Alternative Definitions of the T-Index



Sources: CFTC and authors' calculations